Siemens Smart Cities
Building a Globally Recognized Smart City Development

Lucy Casacia VP Cities and Infrastructure Projects
Vision 2020 – 
Innovation is our lifeblood

5.2 billion €
R&D expenditures in FY 2017

38,000
R&D employees¹

Inventions and patents

7,400
Inventions¹

3,600
Patent applications¹

Cooperation with universities

8
CKI universities²

17
Principal partner universities

¹ In FY 2017
² Centers of Knowledge Interchange
Siemens Canada – A strong local presence

- Approx. 4,300 employees
- Sales of $2.5 billion CAD\(^1\)
- 38 offices
- 14 production facilities

\(^1\) For fiscal year ending September 30, 2017

- Siemens Canada's head office in Oakville, Ontario, has been certified Leadership in Energy and Environmental Design (LEED) Gold for Core and Shell and Commercial Interiors from the Canada Green Building Council.
- The building features a number of energy saving initiatives, including the installation of energy saving lighting, the use of LED signage and the installation of building automation controls and lighting sensors.
- Globally, Siemens aims not only to cut its carbon dioxide emissions in half by 2020 but to become the world’s first major industrial company to achieve a net-zero carbon footprint by 2030.
Siemens Canada - one of Canada’s Top Employers for seven consecutive years.

"Increasingly, employees are expecting that their employers recognize their role in and impact on society. We’re proud to offer our employees opportunities and an ownership culture that help create sustainable value for them, the company and the world around them.”

- Kim Velluso, Vice President Human Resources, Siemens Canada.
Siemens and Cities
Our City of the Future Vision
Intelligently Integrated Developments
A Smart City applies state-of-the-art solutions enabled and improved by holistic integration for the sake of the people, of the administration, of the business as well as of the environment.
Digitalization drives infrastructure of tomorrow

Secure energy supplies, flexible mobility, energy efficient building control – the requirements for sustainable infrastructure are growing. Digitalization enables the implementation of innovative solutions that make urban centers better places to live.

Efficient building management
Better control of building environments not only improves the working or living environment but also reduces the energy consumption of a building. Effective solutions can ensure reliable and efficient operation of buildings.

Reliable, safe and efficient energy
The supply of reliable and affordable energy is an essential condition for economic growth and good quality of life. The grid of the future has to be agile in order to manage our changing energy world.

Smart mobility
Getting from A to B is something people face every day. Improving availability, optimizing throughput and enhancing the passenger experience of our transport networks are key elements of smart and sustainable mobility solutions.

Challenges for Intelligent Infrastructure

5 bn
No. of people living in cities in 2030*

2.5 bn
No. of vehicles in 2030*
+100% compared to 2015

194,000 TWh
Global energy demand 2030
+25% compared to 2012

239 bn
Expected costs resulting from traffic jams in Europe and USA in 2030

15% of greenhouse emissions are contributed by shipping*

~ 5% p.a.
Rate of Data Center power consumption increase to 2030*

40%
Advanced building automation and control systems can save up to 40% of energy*
Digitalization is important for cities.

Delivering city services with current processes & service levels will cost an additional $607 million in 2017 & a further $380 million in 2018.

Implementing a smart city strategy, Toronto can save $1.2 billion & create 19,000 new jobs over 10 years.

Reference: Arup and Toronto Board of Trade
Intelligent Infrastructure
Across the world, infrastructure systems are coming under increasing pressure due to urbanization, globalization and climate change. The scale of the challenge calls for a new, more intelligent approach to infrastructure.

**Challenges**

**More traffic**
The demand for travel within urban areas is expected to triple by 2050.¹

**More fluctuating power**
The share of renewables will rise to 31% of global electricity generation.² How will grids cope with this fluctuating supply?

**Rising energy costs**
Energy accounts for 40% of a building’s operation costs. Businesses must increase energy efficiency in order to remain competitive.

**Solutions**

**In the fast lane**
On the Jerusalem-Tel Aviv highway, it takes only 12 min in the fast lane to travel a 12km stretch that used to take up to an hour. A dynamic toll based on real-time traffic volumes ensures a guaranteed speed of 70km/h.

**Future grids**
By using smart grid technologies, the integration of renewables results in 2% to 40% lower investment costs compared to traditional grid expansions.³

**Virtual power**
In Munich, a virtual power plant combines energy from distributed sources, including renewables, using data on demand and weather forecasts.

The combination of data and engineering is a key enabler for maximizing the capacity and efficiency of infrastructure.

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² For 2011 and 2035. Estimations based on global forecasts.
³ Assuming integration of 20% of renewables.
The market: Moving towards increased intelligent infrastructure

"Brick & Mortar" infrastructure
- Road and rail tracks
- Commercial buildings
- Electrification islands

(Semi-) automated infrastructure
- Electric railways basic rail and road automation
- Modern standard buildings
- Mono-directional power grids

Intelligent infrastructure
- Driverless trains and advanced traffic management
- Fully automated buildings
- Smart grids managing loads, storage and generation

Fully integrated, intelligent infrastructure
- Integrated real-time optimization and real-time dashboards across all infrastructure domains

Increased in productivity, efficiency, capacity and resilience
The Siemens London Crystal

Siemens Crystal

One of the world’s most sustainable building - Smart City project with City of London, UK
Digitalization is driven by The Internet of Things

**Advantages**

Intelligence

Connectivity

Efficiency

Transparency

Flexibility

**Technology**

Cyber-physical systems

Physical world and internet are merging to close gaps of information

**Manufa-cturing**

Smart factory/Industrie 4.0

**Energy**

Smart grid/intelligent infrastructure

**Mobility**

Smart mobility/intelligent infrastructure

**Healthcare**

Smart health

**Logistics**

Smart logistics

**Buildings**

Smart buildings/intelligent infrastructure

**Living**

Smart home

...
Smart Buildings in a Smart Grid: Enabled by ICT technologies

Smart building

- HVAC
- Lighting
- Local Generation
- Power management
- Storage
- E-Mobility

Smart Grid

- Central Generation
- Distributed Generation
- Virtual Power Plant
- Microgrid
- Distribution Automation
- Demand response

Energy and Data flow

- Heat
- Gas
- Water
- Metering

Smart building in the Smart Grid
Significant changes in energy systems
The new age of electricity

… to decentralized energy systems and bidirectional energy balancing
Pushing the integration of infrastructures

Application cases by location of storage

**Central**
Large Utilities

**Pumped storage**
- Electricity
- Grid balancing and stability

**H2**
- Electricity
- H2/ Methane (gas grid)
- Power-to-gas
- Power to value

**Decentral**
Small utilities, municipalities, industry – prosumer

**Battery**
- Electricity
- Grid stability and self-supply

**Thermal**
- Heat (power)
- Power-to-heat
Renewables in Smart City Research
Aspern, Vienna

- Frame strategy of the city of Vienna to migrate to a smart city by 2050
- Resources (energy, mobility, infrastructure, buildings)
- Quality of live (social inclusion, participation, health, environment)
- Innovation (education, economy, research, technology)

- Total size: 2.4 million m²
- One of European biggest developing area
- More than 20 000 m² area for shops, restaurants and small and medium sized companies
- Workplaces: 20 000
- Residents: 20 000
- High class apartments: 10 500
- Apartments, offices, business areas, science, research and education
What Siemens See As the City of the Future
Smart, Resilient, Sustainable
City of the Future
Smart City Framework

Siemens delivers technology that enables developments like Assembly to be smart, safe, efficient, and connected. We take a life cycle approach to development & construction, help manage your assets and meet or exceed your ROI criteria. We can do this through our expertise in some of the following areas:

- **Smart Micro grids & smart utility metering**
- **Residential & commercial building analytics**
- **Parking & wayfinding solutions**
- **Safe Access control & video**
- **Command & control centers with video analytics**
- **Smart streetlights**
- **Emergency call stations**
- **Mass notification**
- **Efficient HVAC controls & building automation**
- **Lighting & shade control**
- **Connected Community mobile apps and websites**
- **Integrated Management Systems**
- **Life Cycle Water conservation**
- **Waste to energy (WTE) solutions**
- **Optimized central plant/district heating & cooling**
- **Asset Management**
- **Technology master planning**
- **Design, build, operate & maintain**
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- Access control & video
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- Smart streetlights
- Emergency call stations
- Mass notification

**Efficient**
- HVAC controls & building automation
- Lighting & shade control

**Connected**
- Community mobile apps and websites
- Integrated Management Systems
- Water conservation
- Waste to energy (WTE) solutions
- Optimized central plant/district heating & cooling
- Asset Management

**Smart Energy**
- Advanced traffic management
- eMobility
- Smart parking
- App based transport
- Micro grids
- Smart utility metering
- Battery storage
- Distributed energy
- eCar charging
- HVAC building automation
- Lighting systems
- IoT devices
- Life safety and security

**Digital City**
- & Comms Networks

**Networks**

**Environmental Care**

**Intelligent Urban Infrastructure**

**Data analytics**

**Resilient**

**Agile**

**Smart City**

**Public Safety & Security**
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**Safe**
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- Command & control centers with video analytics
- Smart streetlights
- Emergency call stations
- Mass notification

**Efficient**
- HVAC controls & building automation
- Lighting & shade control

**Connected**
- Community mobile apps and websites
- Integrated Management Systems
- Responsive data analytics

**Life Cycle**
- Water conservation
- Waste to energy (WTE) solutions
- Optimized central plant/district heating & cooling

**Asset Management**
- Technology master planning
- Energy master planning
- Sustainability master planning

**Digital City & Comms Networks**
- Integrated Mobility Platform
- Car2x Networked Driving
- Autonomous Driving

**Public Safety & Security**
- Intelligent Urban Infrastructure

**Resilient**
- Technology master planning
- Energy master planning
- Sustainability master planning

**Data analytics**
- Community mobile apps and websites
- Integrated Management Systems
- Responsive data analytics
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- Smart streetlights
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**Efficient**
- HVAC controls & building automation
- Lighting & shade control

**Connected**
- Community mobile apps and websites
- Integrated Management Systems
- Technology master planning
- Design, build, operate & maintain

**Data analytics**
- Environ-mental Care

**Digital Devices**
- Digital City & Comms Networks

**Hi-Speed Connectivity**
- Optical fiber infrastructure
- >100 mbps broadband

**Digital City**
- Smart services

**Resilient**
- Public Safety & Security

**Agile**
- Intelligent Urban Infrastructure

**Wireless Coverage**
- Smart City
- Optical fiber infrastructure
- >100 mbps broadband
- Smart phones/tablets
- Connected home automation
- Home safety and security
- Ultra high-speed Wi-Fi
- Underground Wi-Fi coverage
- Low freq Bluetooth beacons
- Underwater Wi-Fi coverage
- Low freq Bluetooth beacons
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**Efficient**
- HVAC controls & building automation
- Lighting & shade control

**Connected**
- Community mobile apps and websites
- Integrated Management Systems

**Life Cycle**
- Water conservation
- Waste to energy (WTE) solutions
- Optimized central plant/district heating & cooling

**Data analytics**
- PM 2.5/ PM 10
- CO2eq, CO, NOx, SOx
- Forecasting Model
- Low Emissions Zone

**Resilient**
- Quality control and automation of water treatment
- Supervision & control of distribution of water
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**Smart**
- Micro grids & smart utility metering
- Residential & commercial building analytics
- Parking & wayfinding solutions

**Safe**
- Access control & video systems
- Command & control centers with video analytics
- Smart streetlights
- Emergency call stations
- Mass notification
- Resilient power supply

**Efficient**
- HVAC controls & building automation
- Lighting & shade control

**Connected**
- Community mobile apps and websites
- Integrated Management Systems

**Life Cycle**
- Water conservation
- Waste to energy (WTE) solutions
- Optimized central plant/district heating & cooling

**Asset Management**
- Technology master planning
- Design, build, operate & maintain

**Weather Hazards**
- Early warning & mass notification
- Flood control
- Resilient power supply

**Fire Safety**
- Evacuation systems
- Building fire detection and extinguishing
- Emergency call stations
Intelligently Integrated Developments
Austria, UK, Australia, China, US and Canada
Integration of:
1. Electric Metering
2. Solar Metering
3. Gas Metering
4. Geographic Information System
5. Community Mobile App
6. Community Website
7. Irrigation Monitor/Control
8. Street Lights Monitor/Control
9. Security POE Cameras
10. Security Access Control
11. Security Video Analytics
12. Residential & Commercial
13. Automation Analytics
14. Traffic Signal Monitoring
15. Community Analytics
16. License Plate Recognition
17. Security Mass Notification
18. EV changing stations
Siemens and Algonquin College are inspiring future sustainability leaders: fostering tomorrow’s environmental stewards via applied learning on innovative sustainable energy technologies

- Algonquin College is helping students move society toward a greener future through its in-class curriculum, applied learning focus, its unique energy management system and its high-performance buildings.

- Algonquin College aims to be a net carbon zero institution by 2042. It is already leading by example – generating its own energy, storing the energy and managing the energy with a sophisticated Siemens microgrid.

- Siemens and Algonquin College have partnered to create a unique green culture at Algonquin College, including a new sustainability graduate certificate program. And sustainability is integrated into the curriculum of all undergraduate disciplines.

- Innovative building technology drives energy efficiency in four state-of-the-art LEED certified buildings.
Aspern Vienna’s Urban Lakeside Cooperative
Smart Building, Smart Grid, Smart User, Smart ICT.

- 593 acres, brown field redevelopment
- $5B Investment
- 20,000 targeted to live/work/play by 2029

SMART BUILDINGS
Buildings optimise their energy needs and operate flexibly

SMART GRID
The path to intelligent networks

- Real time utility switching
- Fully networked smart metering
- Bi-directional smart grid

Vienna, Austria ranked #1 on the United Nations Livable Cities Index
Aspern Vienna’s Urban Lakeside Cooperative
Smart Building, Smart Grid, Smart User, Smart ICT.

- 8,500 residential units by 2029
- Remote mobile access
- Selection of utility rate and tariff, by user

- Integrated network of utilities, grid controls, building and home feedback, with data analytics
- Opt-in collection of in home utility usage data…for
- academic research and impact to future home design

Source: ASCR

One of Europe’s largest urban development projects is taking shape on a former airfield
Silvertown Quays, London
London’s new technology district

• 62 acre brown field re-development

• 3000 residential units

• 7 m square feet of development
  • Reintroduction of urban manufacturing

• Creation of 21,000 jobs
NB Power leveraged Siemens comprehensive Compass methodology and employee expertise. An extremely close working relationship between integrated teams of Siemens and NB Power employees.

Approx 150 “smart grid” initiatives underway, including introduction of intelligent load management software to help customers lower their energy costs by reducing and shifting demand for electricity.

Innovations in data analytics and other software mean more consistent service, fewer outages and more uptime, as well as a future of greener energy.

Siemens Canada is a Global Centre of Competence for smart grid and is a founding partner of the Smart Grid Innovation Network, a collaboration between Siemens, NB Power and the University of New Brunswick.
The flagship plant of Enwave needed a major upgrade to their electromechanical control technology. Siemens was responsible for supply, engineering, installation, maintenance and support of a state-of-the-art control system and the intelligent field instruments connected to it. Siemens stood out as the best option because of the superior reliability of its solution, as well as an easy-to-use Human-Machine Interface, advanced field instrumentation, competitive pricing and exceptional after-sales support. PCS 7 from Siemens reduces Enwave’s carbon footprint and emissions, improves plant efficiency and capacity, optimizes operations and reduces costs.
The Tonsley Innovation District
Australia’s Silicon Valley

- 150 acre redevelopment
  - Was an automotive manufacturing/assembly plant
- 30 acres of high density residential
- Partnered with neighboring University and Tech College
  - Train and develop “new energy” labor force
- Privatized dedicated fiber optic network
- On-site distributed energy generation, w/ smart grid
- Achieved 6-Star Green Star — Communities certification
Sterling Ranch, Colorado
Colorado’s 1st Gigabyte Community

- 3,400 acre greenfield development
  - Entitled for 12,050 residential units
  - 3 million sq feet of commercial
  - 1.4 million square feet of institutional
- 12 filings, 20 year build
- Anticipated 35,000+ residents and 15,000 jobs
- Vision is to create North America’s most “connected” suburban community
Sterling Ranch, Colorado
Colorado’s 1st Gigabyte Community

- Invested in privatized dedicated fiber network
- Fully connected community
  - Smart street and trail lighting
  - Water wise metering and irrigation
  - Distributed energy systems
  - Battery storage
  - Suite of in-home technology solutions
- In development of in-home predictive utility analytics
- Use of mobile community app
- Deployment of blue tooth beacons
What Technology Could Do

Use Case
Siemens is working on a waste-to-energy plant in Vienna, Austria, which turns sludge into power and leaves clean water as a byproduct.

Microgrids can easily incorporate renewable energy and can go off-grid in emergency situations.

CHP is a more efficient way to turn natural gas into heat and power, and can also operate off of renewable energy.
AUTOMATED PEOPLE MOVER

Automated trains connect terminals at various airports

PARKING MANAGEMENT

License-plate recognition software, incorporated with cameras, payment systems, and space sensors, facilitates smart and quick parking.

SHARED, ELECTRIC, CONNECTED, AND AUTONOMOUS VEHICLES

Electric charging infrastructure can be mobile or fixed.

SMART STREET LIGHTING

Cities around the country are pursuing smart street lighting, air quality sensors, intelligent traffic light systems, and security systems.
BUILDING AUTOMATION

SMART METERING

PORTFOLIO CONTROL

Portfolio control software with a slick user interface allows building managers to view energy usage across a campus of buildings.

FIBER

High-speed Internet connections are key to digital connectivity.
Technology Lookbook
Role of the Residents – Prosumers

ENERGY GENERATORS

PRODUCT CREATORS

RESOURCE HARNESSERS

HOUSEHOLD ENERGY MANAGERS

SMART STAKEHOLDERS

RESOURCE PRODUCERS
3 Technology Partnerships Defined

What is it?
How we get there?
How can Siemens help?
Smart Cities - Lessons learned:

✓ Each transformative mixed-use development is unique;
  • economically,
  • politically,
  • socially,
  • environmentally,
  • chronologically

✓ Successful transformative mixed-use developments, from a technology perspective, share:
  • sound long-term vision,
  • strong local support,
  • technology roadmap, with use cases,
  • plan for long-term connectivity,
  • early engagement of technology partnerships for master planning and implementation
Lessons learned:

✓ Mistakes and consequences:

- Lack of standardization – increase in life-cycle costs
- Not identifying a technology target – settling for what you get…
- Lack of attention and emphasis on infrastructure – lack of connectivity and speed, and not being able to support emerging technology “edge” devices
- Lack of security considerations – not being able to evolve to “smart” and safe solutions
- Lack of focus on use cases and user experience – owning systems that cannot integrate or of little value
- Lack of integration of systems – loss of user capabilities and loss of valuable data for analytics
Financing
Considerations
PERFORMANCE-BASED CONTRACTING – Technologies

EQUITY INVESTORS – Launch of a ‘green’ property fund

ENERGY – Local utility energy efficiency tariffs and programs

“GREEN”/”SMART” BOND – Start-ups like Neighborly are boosting municipal bonds

SPECIAL PURPOSE VEHICLE, JOINT VENTURE – Use PPP’s to enhance credit opportunities

STAGGER PROJECTS GENERATING REVENUE FOR ADDITIONAL PROJECTS
5 Path Forward
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